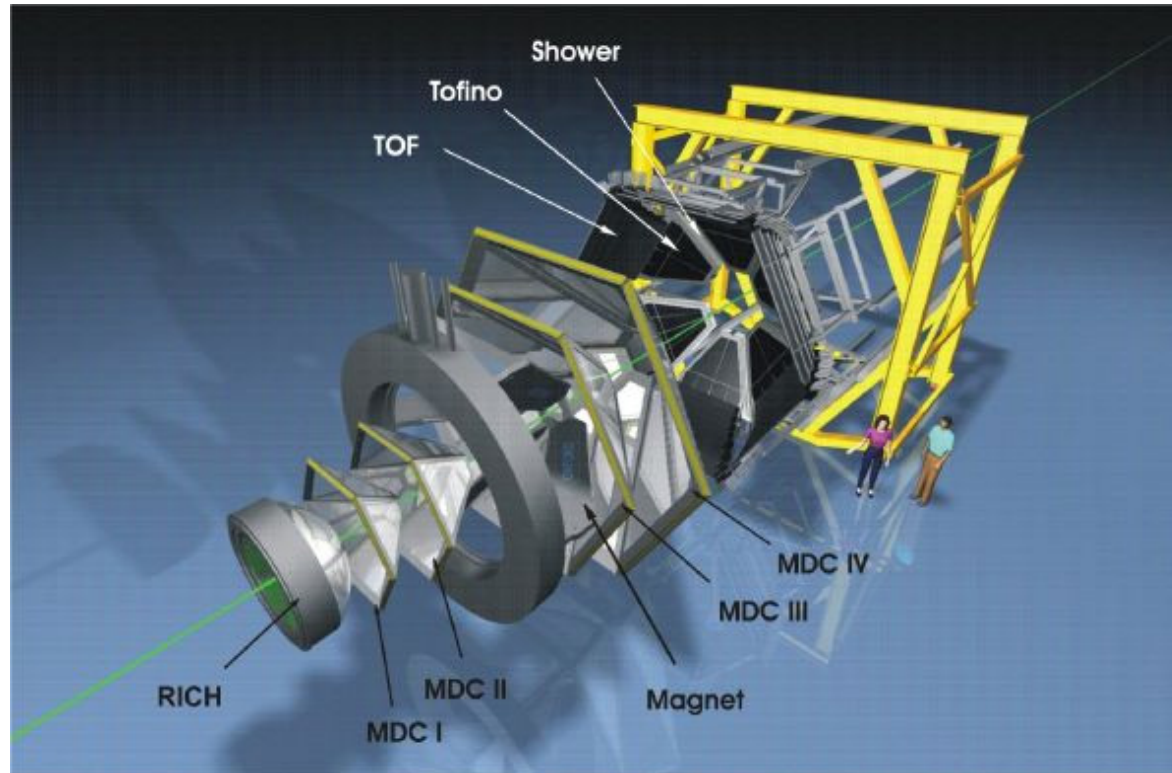


Single and Double Pion Production in the np-Collisions at 1.25 GeV with HADES

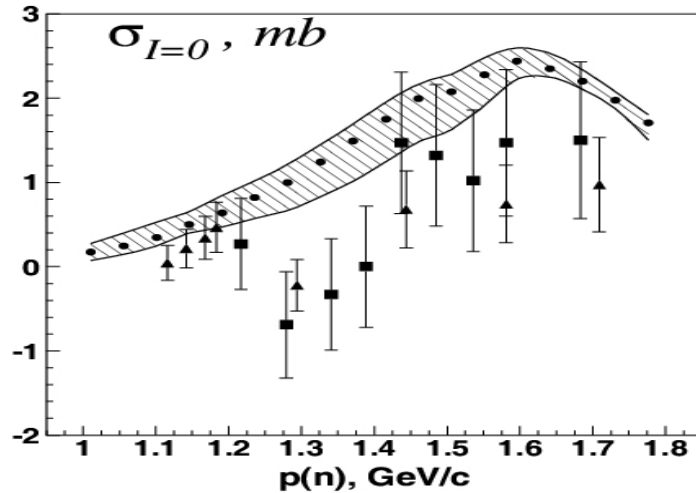


A.K.Kurilkin (LHEP-JINR) for the HADES collaboration

Outline

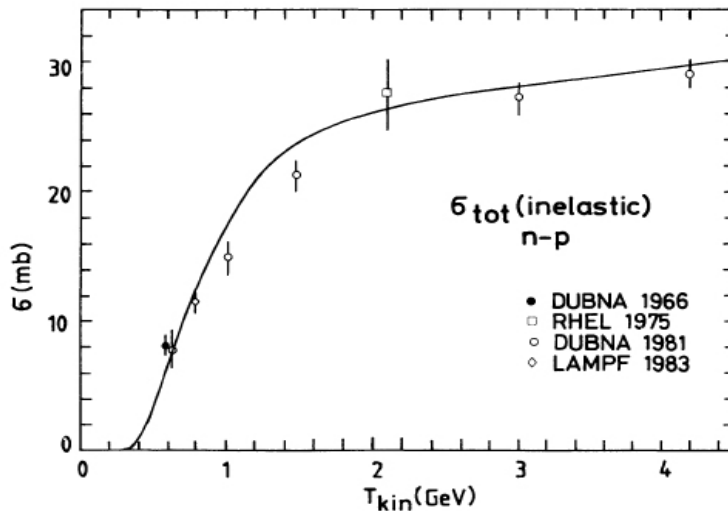
- Introduction.
- HADES spectrometer.
- Identification of hadrons.
- Results.
- Conclusion.

Introduction



V.V.Sarantsev et. All Eur. Phys.J. A 43, (2010)

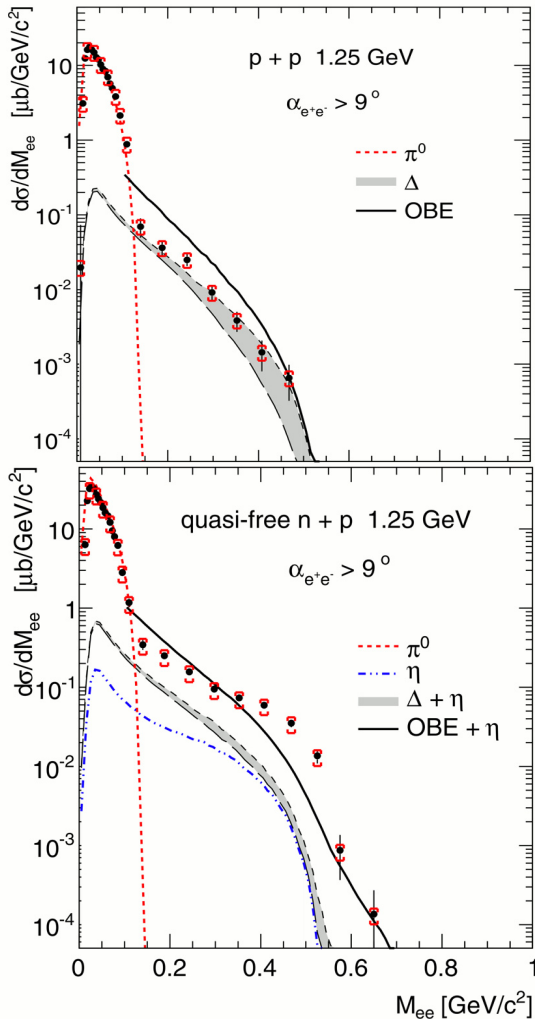
- Data on low energy p-n interactions are important as well for understanding of the NN interactions as for interpretation of medium energy heavy ion interactions. However, the relevant data are scarce.
- Study of np reaction is important to obtain the contribution of isoscalar ($I=0$) partial waves to the inelastic np collision.
- Study of reactions with single and double pion production in the np collisions at different energies is important for the determination both of the energy dependences of the total np cross section and the contribution of inelastic channels to np interactions.



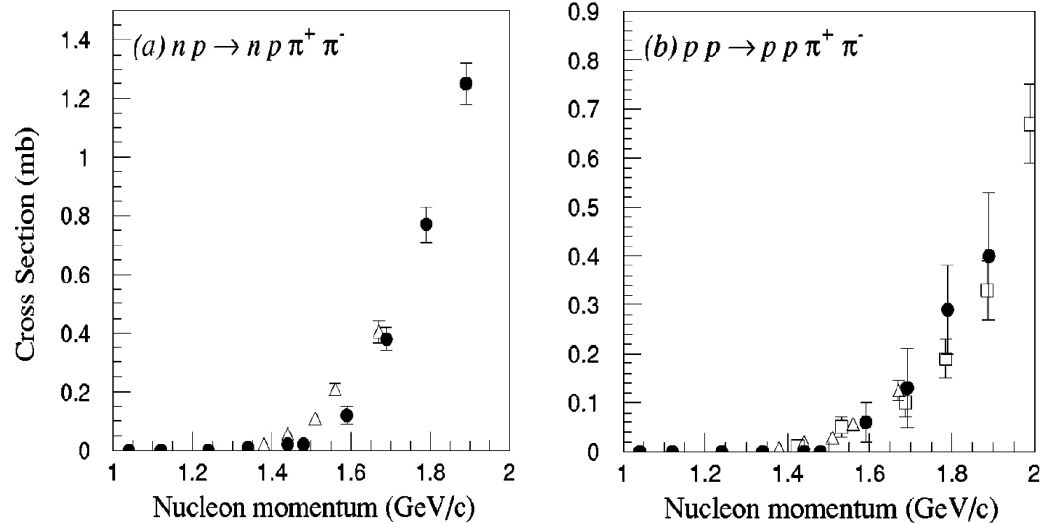
J.Bystricky et. all, J. Physique 48 (1987)

Introduction

- The comparison of double pion production from np and pp interaction can bring new constraint on the recently reported e^+e^- excess in pn reactions (see publications of the HADES collaboration).
- New HADES data will extend the range of momentum dependences of the cross section for the $np \rightarrow np\pi^+\pi^-$ reaction.



G.Agakichiev et al.,
Phys.Lett.B690 118-122 (2010)



T.Tsuboyama et al., *Phys.Rev. C62* (2000)

F.Shimizu et al., *Nucl. Phys. A386*, (1982)

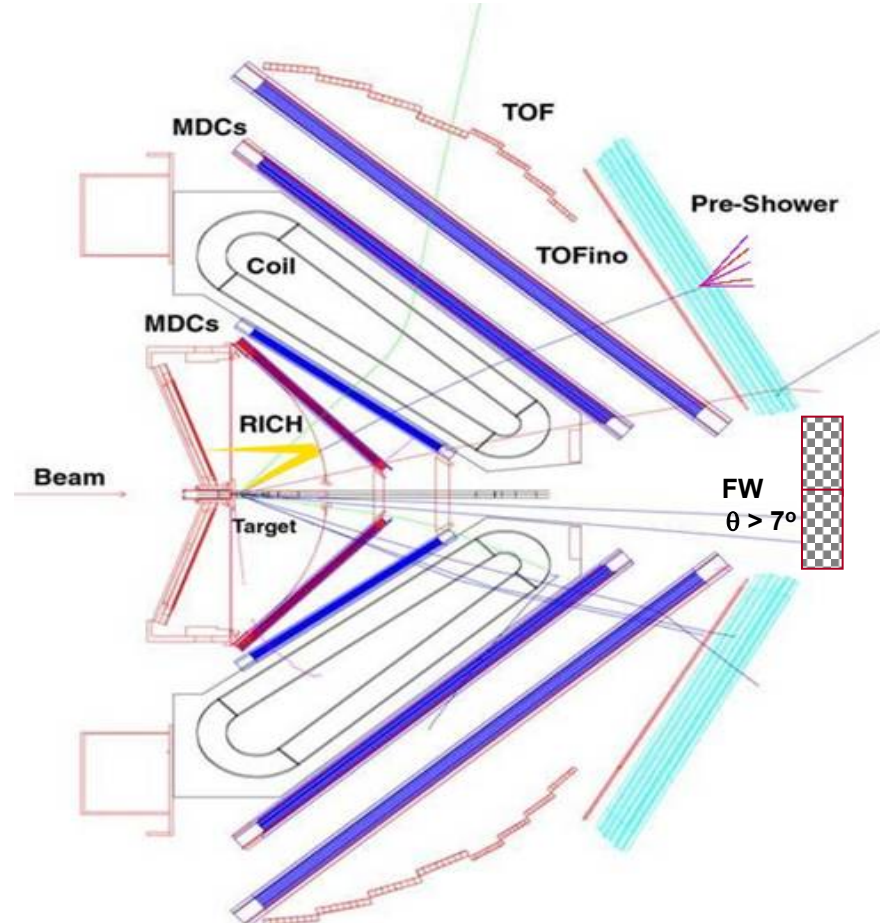
L.G.Dakhno et al., *Sov. J. Nucl. Phys. 37* (1983)

HADES experiment at SIS18, GSI

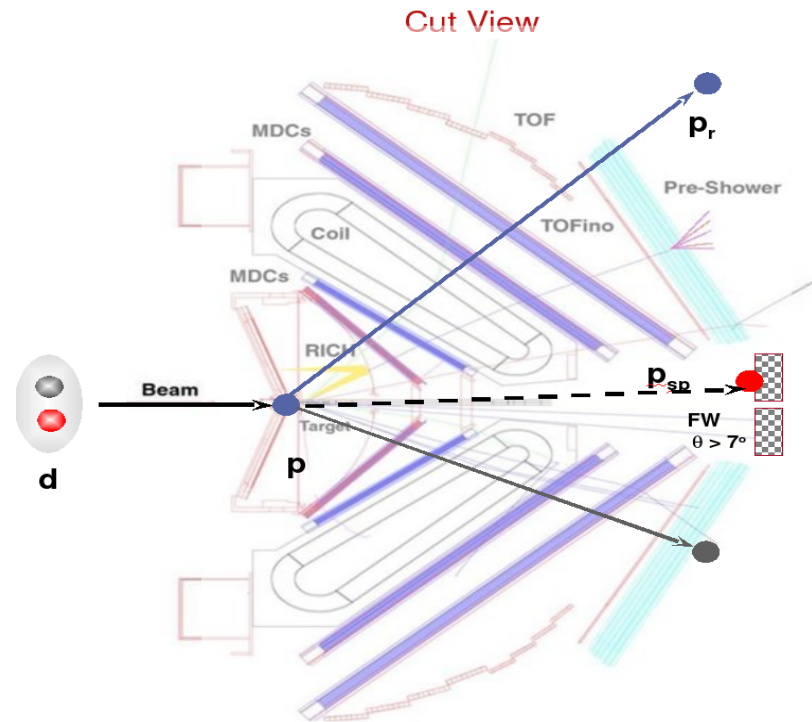
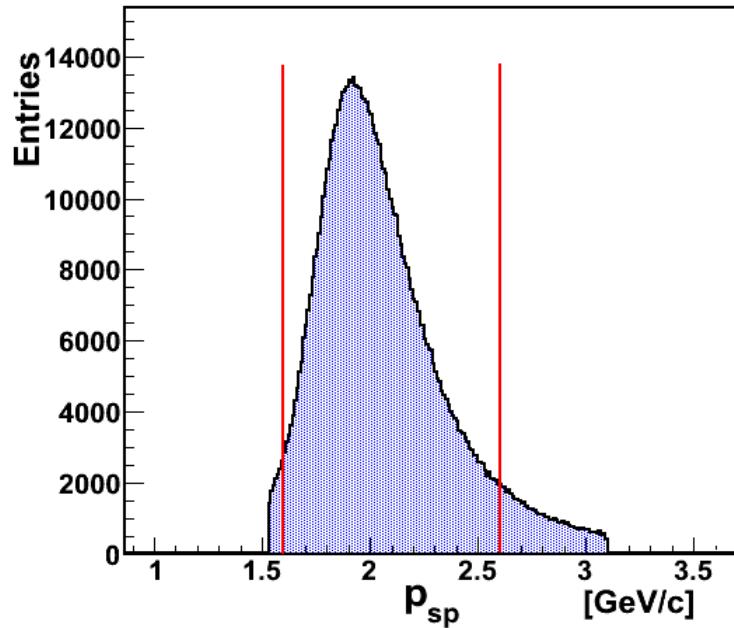
Spectrometer with ...

- High geometrical acceptance
 - Full azimuth, polar angles $18^\circ - 85^\circ$
 - Pair acceptance ≈ 0.35
- High invariant mass resolution (2.5% at ρ/ω pole mass)
 - Low-mass tracking (superconducting toroidal magnet & multi-wire drift chamber (MDC), single cell resolution ≈ 100 mm)
- Powerful PID capabilities: d/p/K/p/e
 - RICH, TOF/TOFino, Pre-Shower, FW hodoscope: added 2007
- High background rejection & rate capability, dedicated LVL2 trigger:
 - LVL1: charge particle multiplicity
 - LVL2: single electron trigger

Cross section

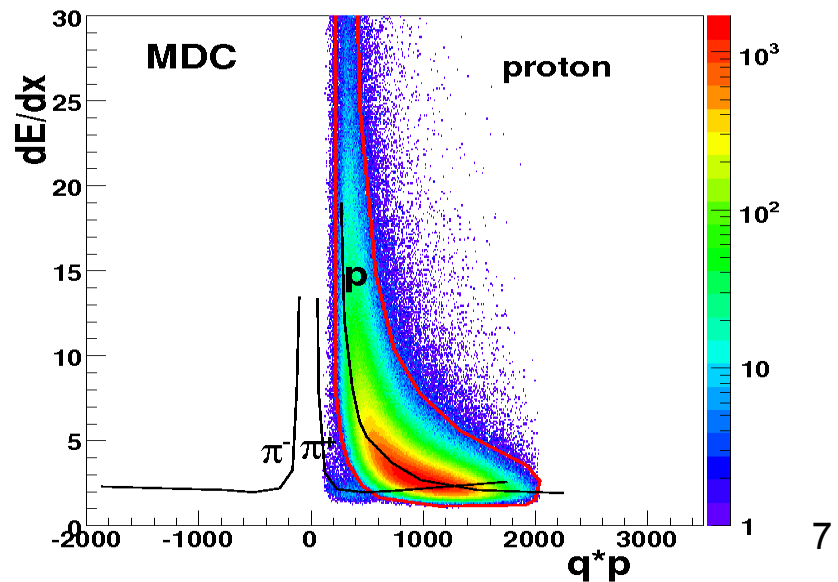
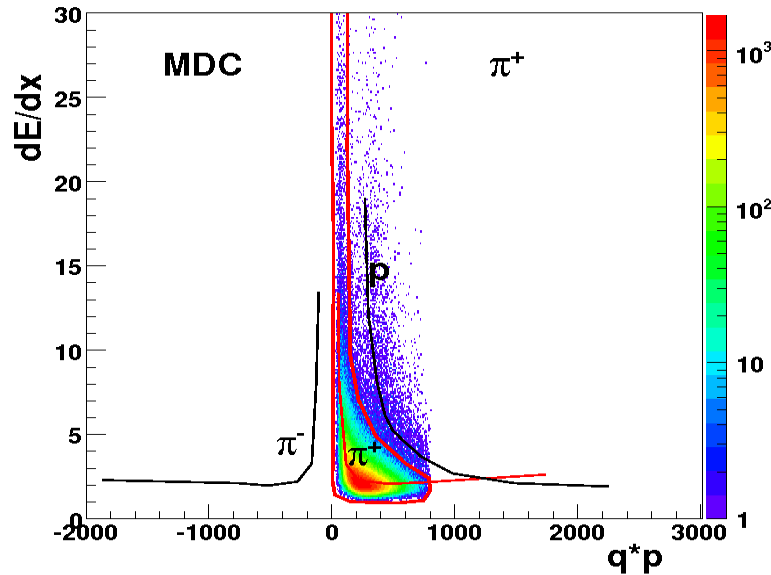
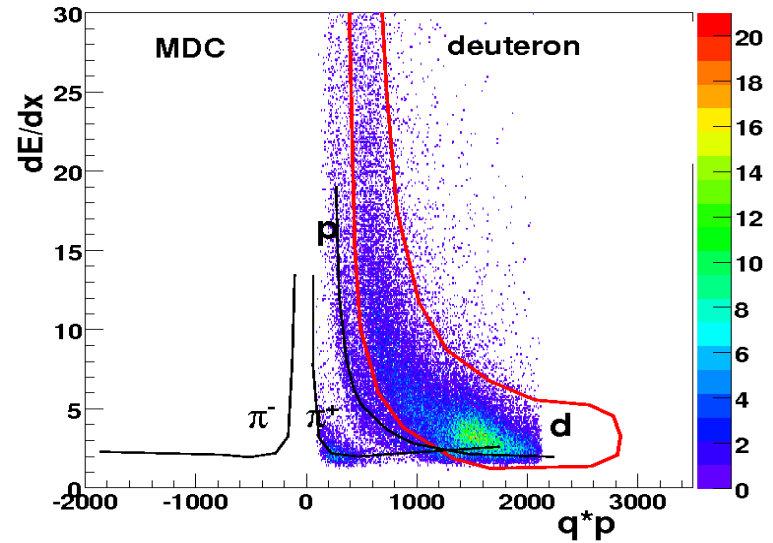
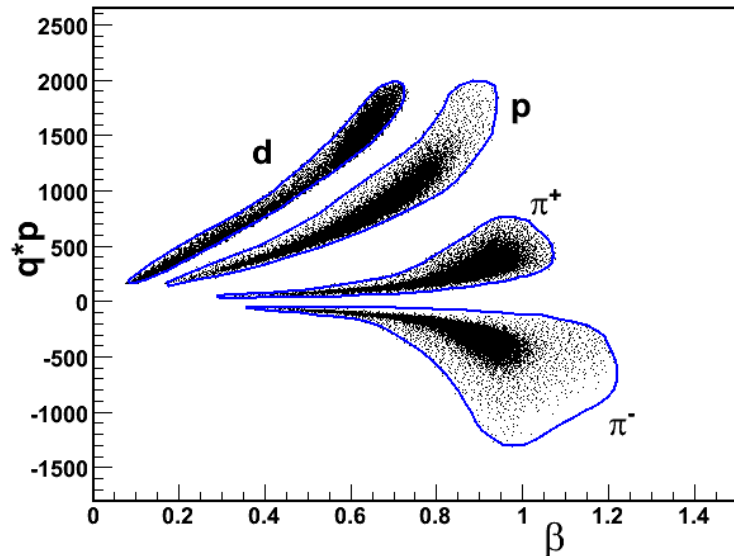


Selection of np interactions from dp one

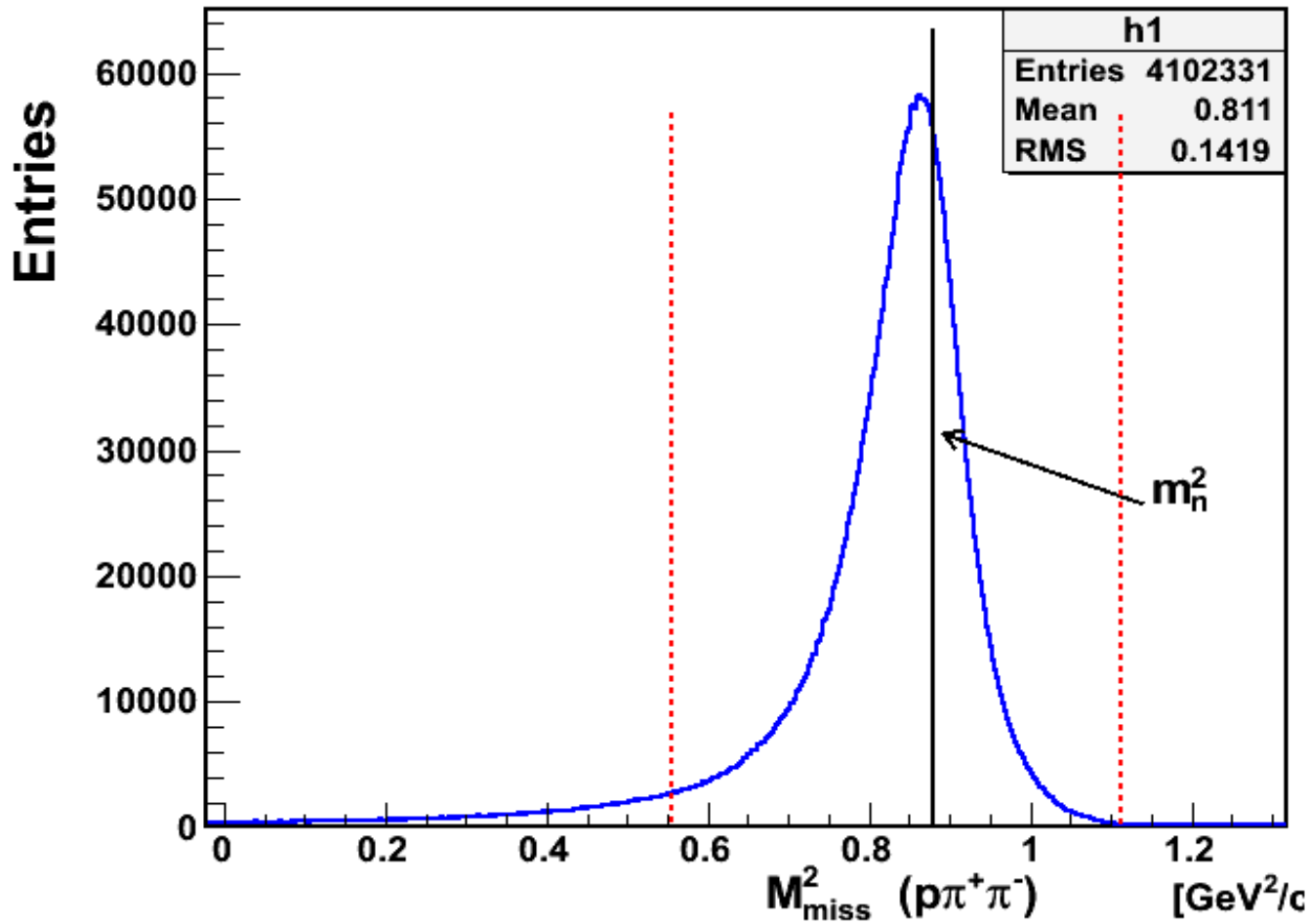


- Proton-spectator in the FWall is the necessary condition for the np channel.
- Spectators were selected according to the condition that their momentum belongs to the interval $1.6 \text{ GeV/c} < P_{sp} < 2.6 \text{ GeV/c}$

Determination of the hadron's type

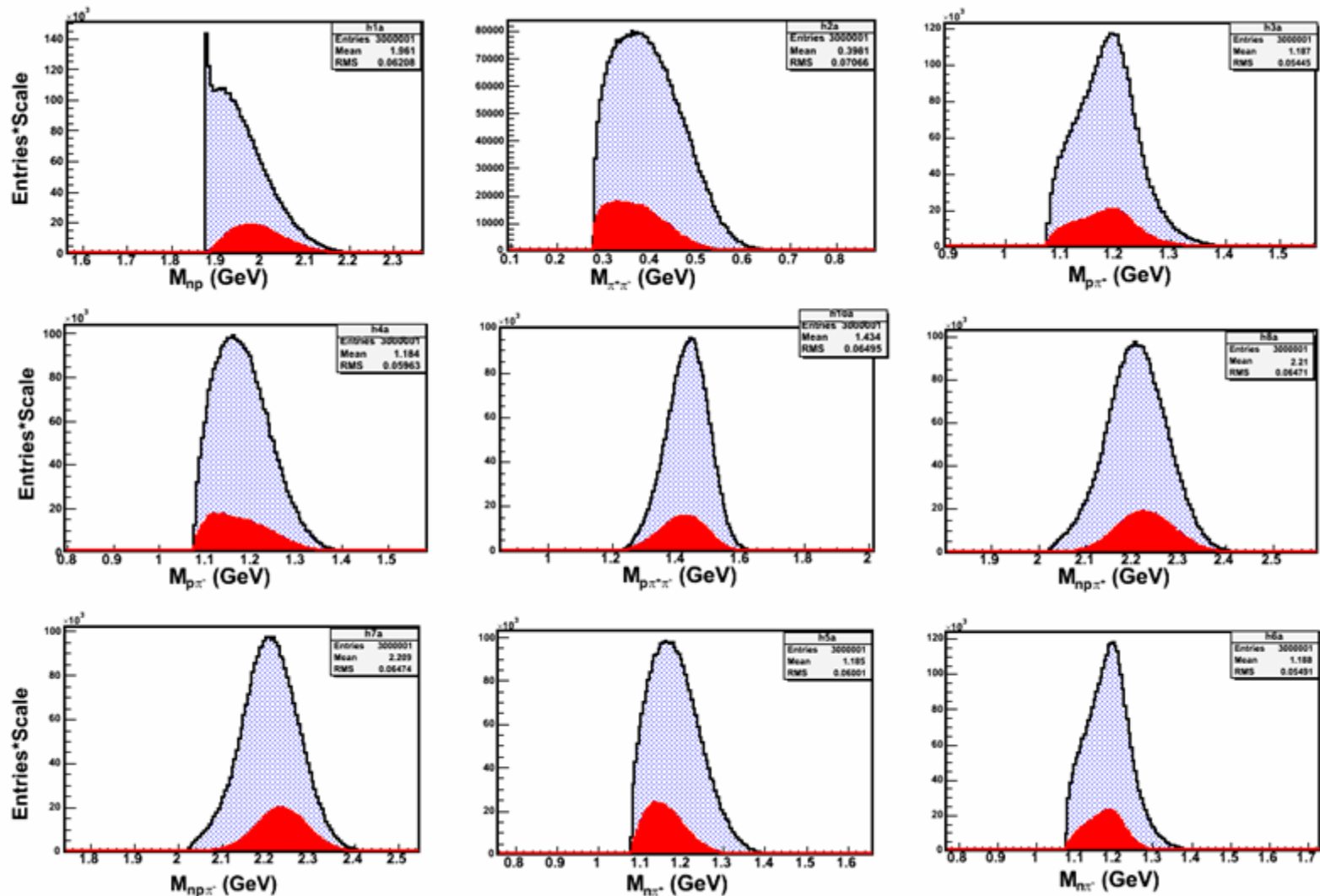


Squared missing mass of $p\pi^+\pi^-$ for $np \rightarrow np\pi^+\pi^-$ reaction



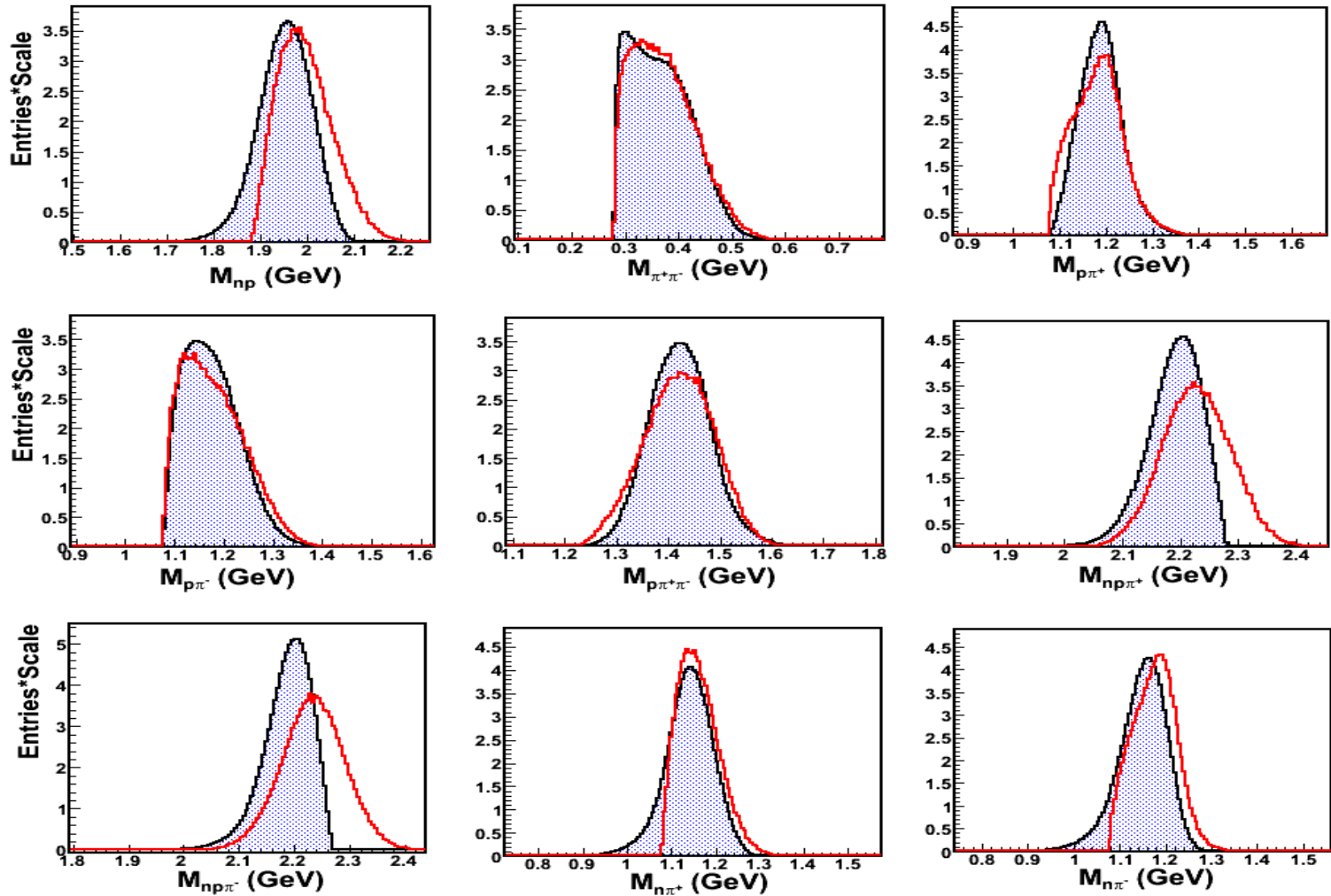
Vertical line corresponds to the squared neutron mass.

Simulation of $np \rightarrow np\pi^+\pi^-$ interaction (A.P.Ierusalimov)



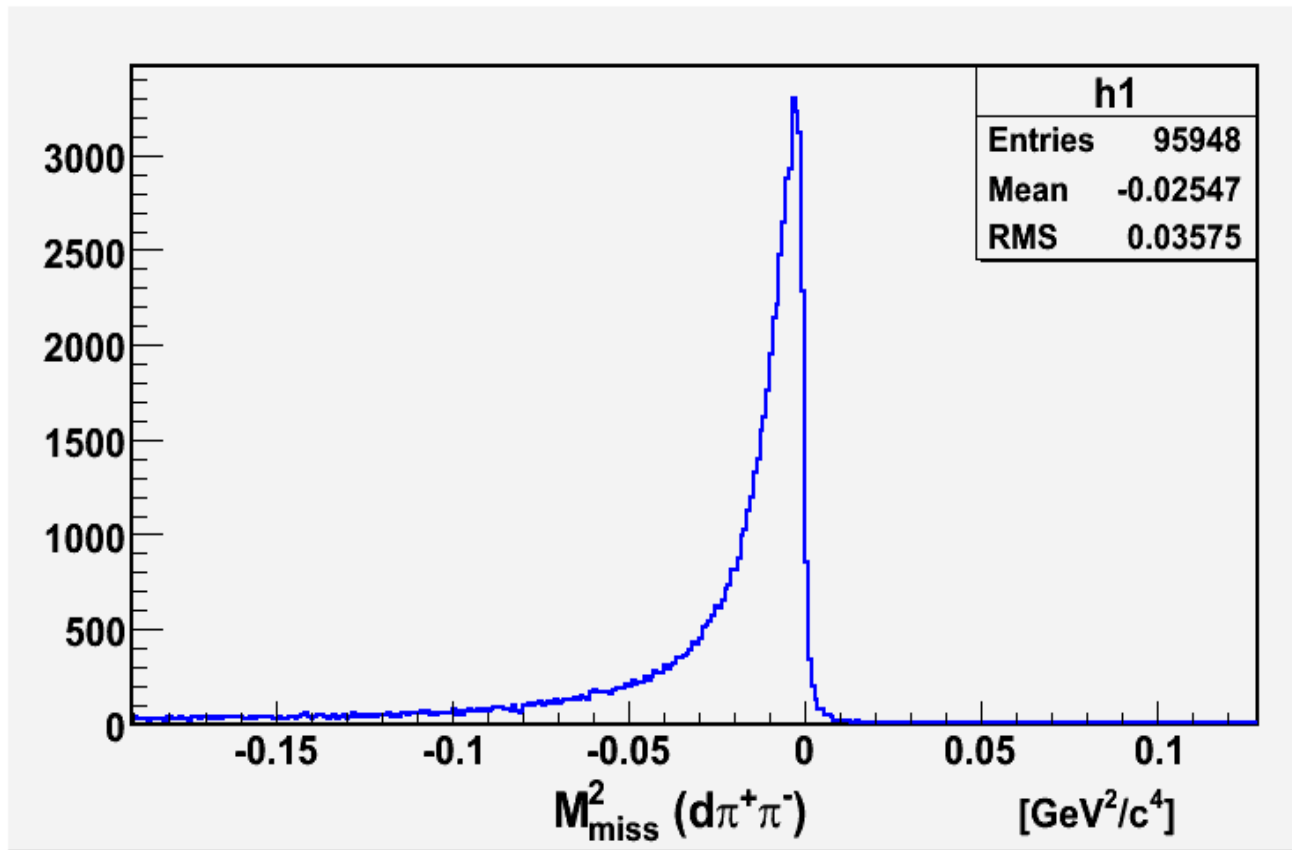
Red histograms correspond to the events which belong to the HADES acceptance.
 Model : **OPE + OBE**. (A.P.Ierusalimov et al. JINR Rapid Communications No.2[35]-89)

Effective mass spectra for $np \rightarrow np\pi^+\pi^-$ interaction

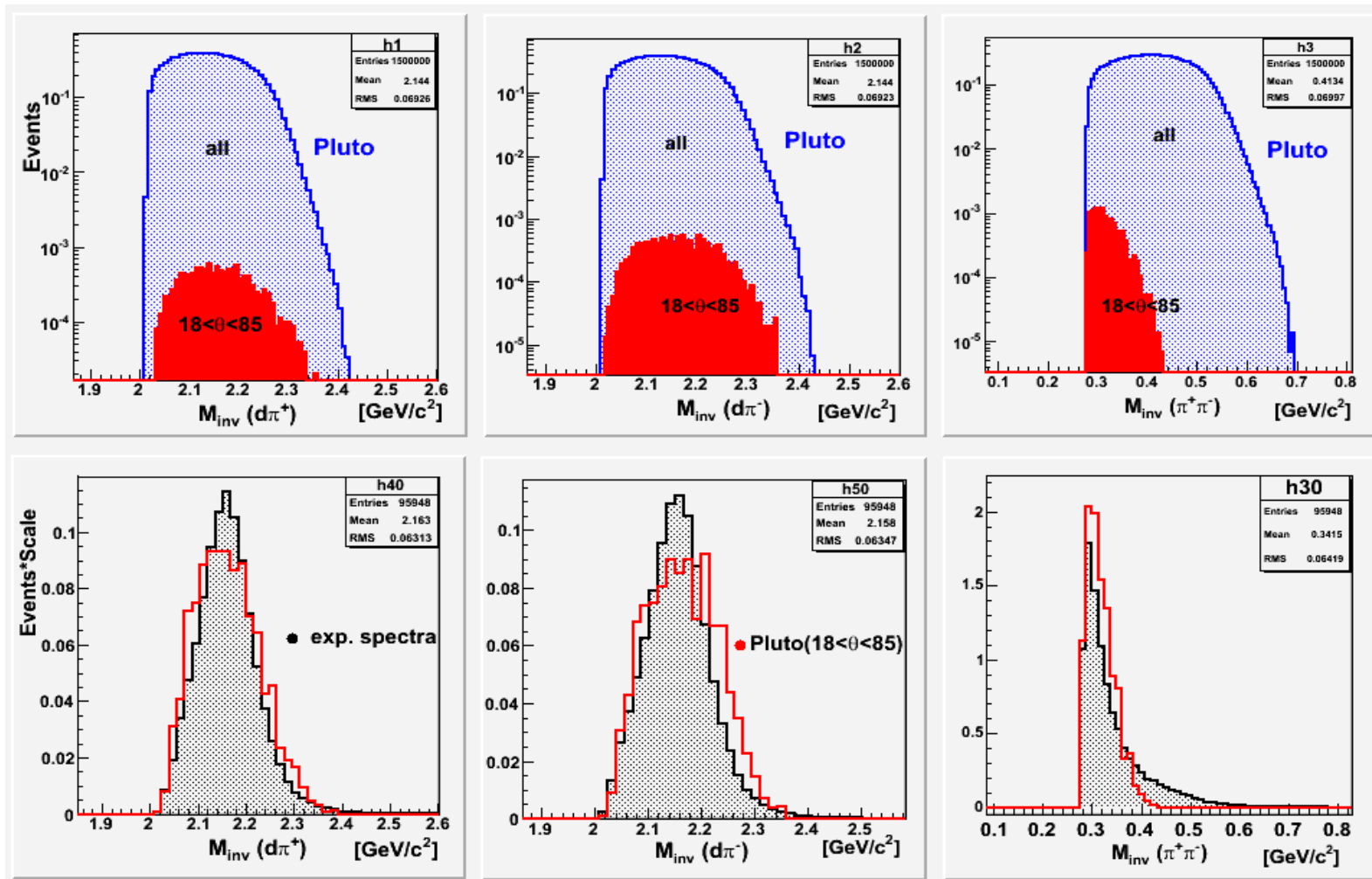


Experimental data are not efficiency corrected.

Squared missing mass of $d\pi^+\pi^-$ for $np \rightarrow d\pi^+\pi^-$ reaction

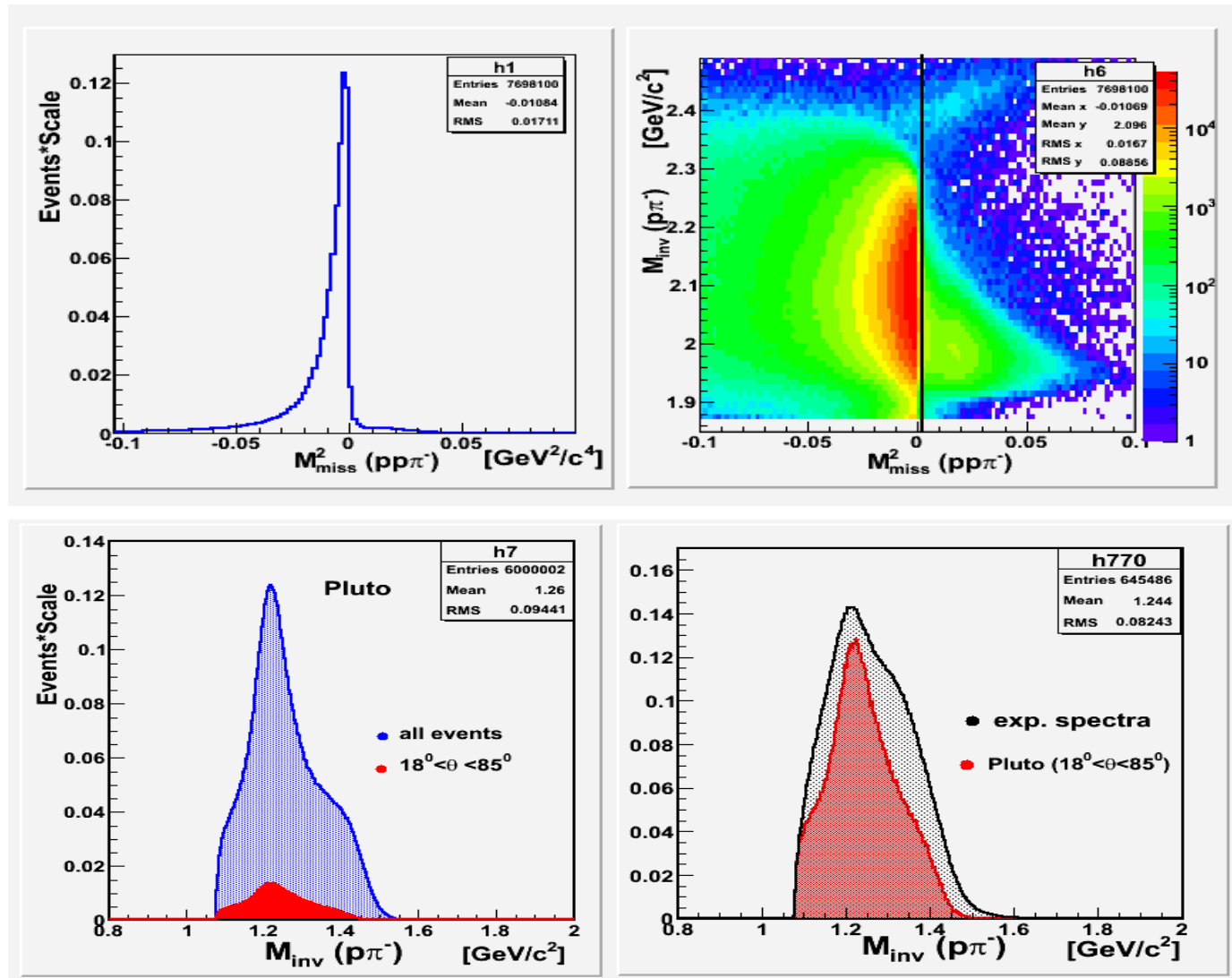


Effective mass spectra for $np \rightarrow d\pi^+\pi^-$ reaction



Upper panel correspond to the events obtained by using Pluto generator. Preliminary experimental spectra are shown by black histograms. *Experimental data are not efficiency corrected.*

Experimental spectra for $np \rightarrow pp\pi^-$ interaction



Experimental data are not efficiency corrected.

Conclusion

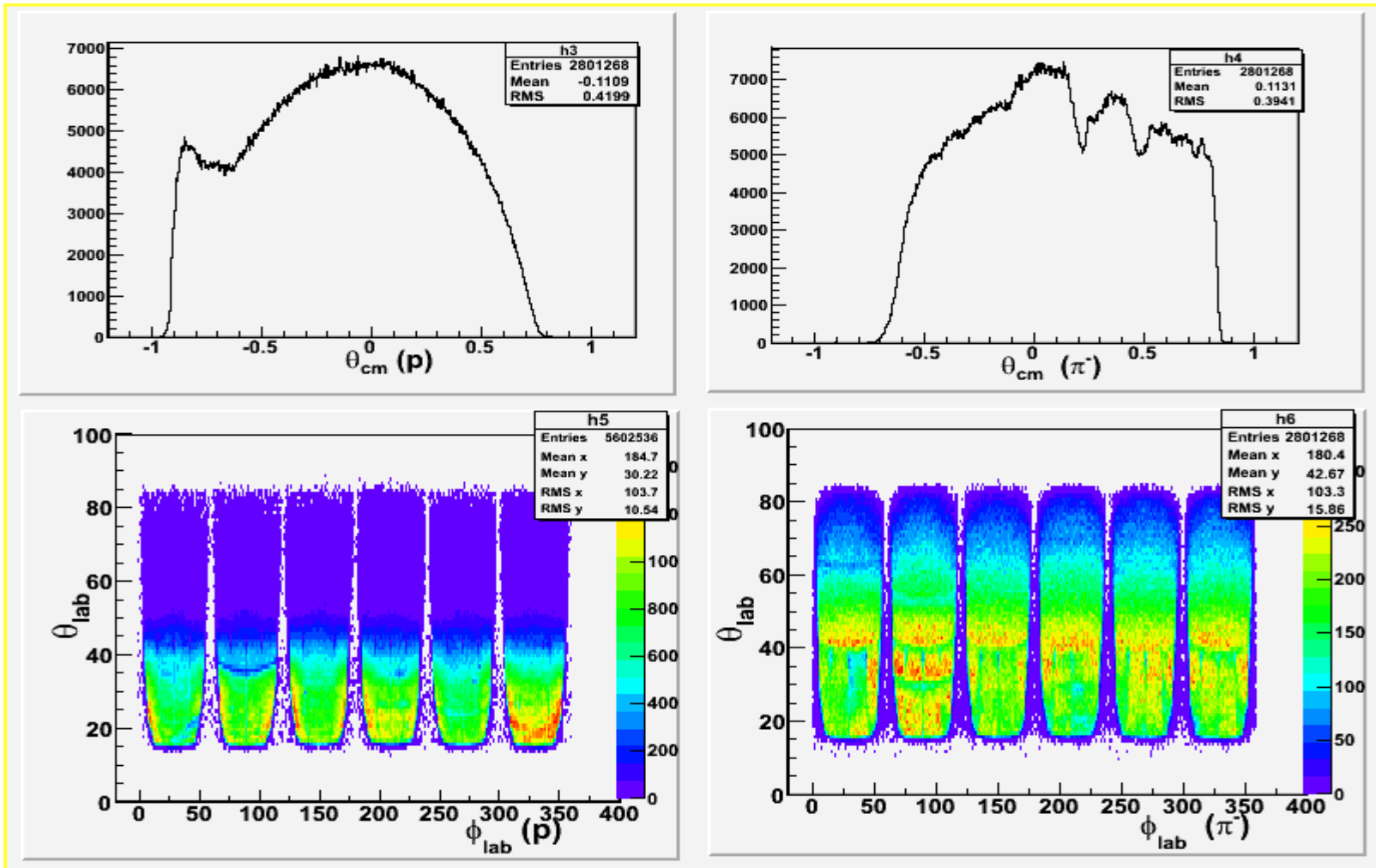
- The preliminary results for the $np \rightarrow np\pi^+\pi^-$, $np \rightarrow d\pi^+\pi^-$ and $np \rightarrow pp\pi^-$ channels at 1.25 GeV are obtained.
- Spectrum of $M_{\text{inv}}(p\pi^-)$ for $np \rightarrow pp\pi^-$ channel shows $\Delta(1232)$ peak.
- These data will serve as an entry for both further analysis steps and comparison with different models on charged pion production in NN collisions at high energies.

Acknowledgements

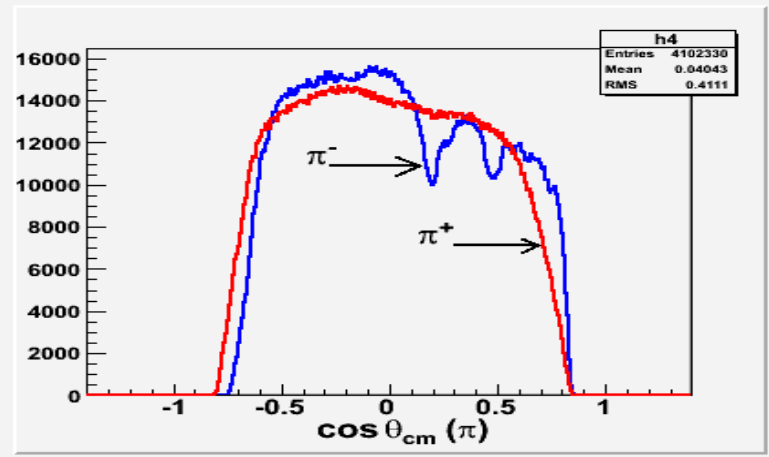
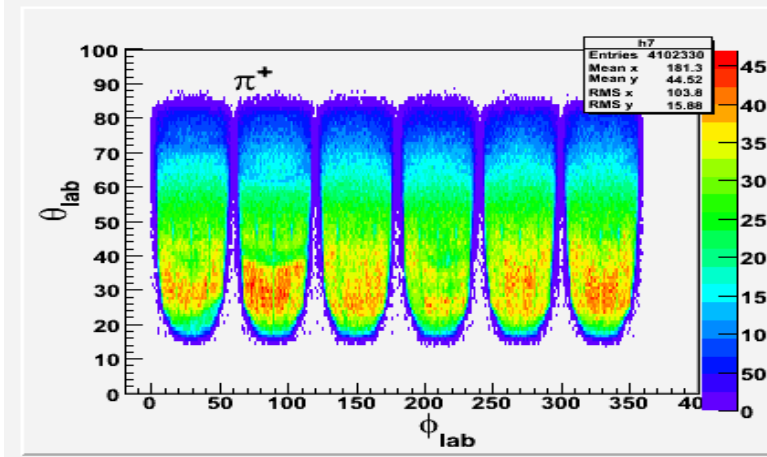
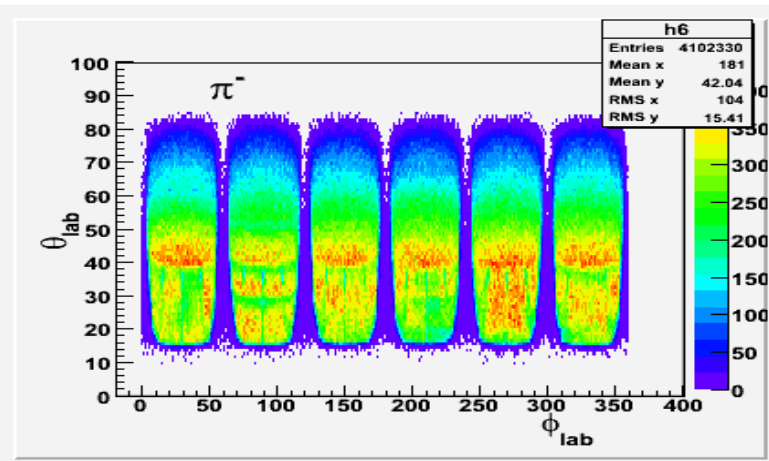
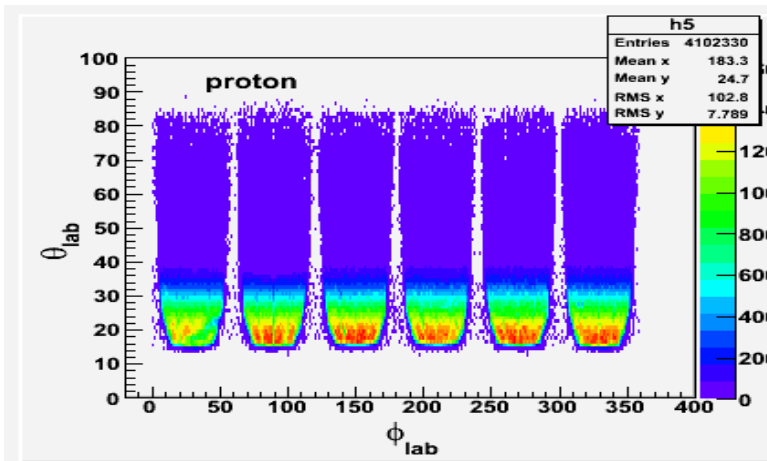
Thanks to A.Rustamov, V.Pechenov, O.Pechenova, K.Lapidus, T.Galatyuk, G.Agakishiev and other people who helped us in our analysis!!!

Thank you for attention!!!

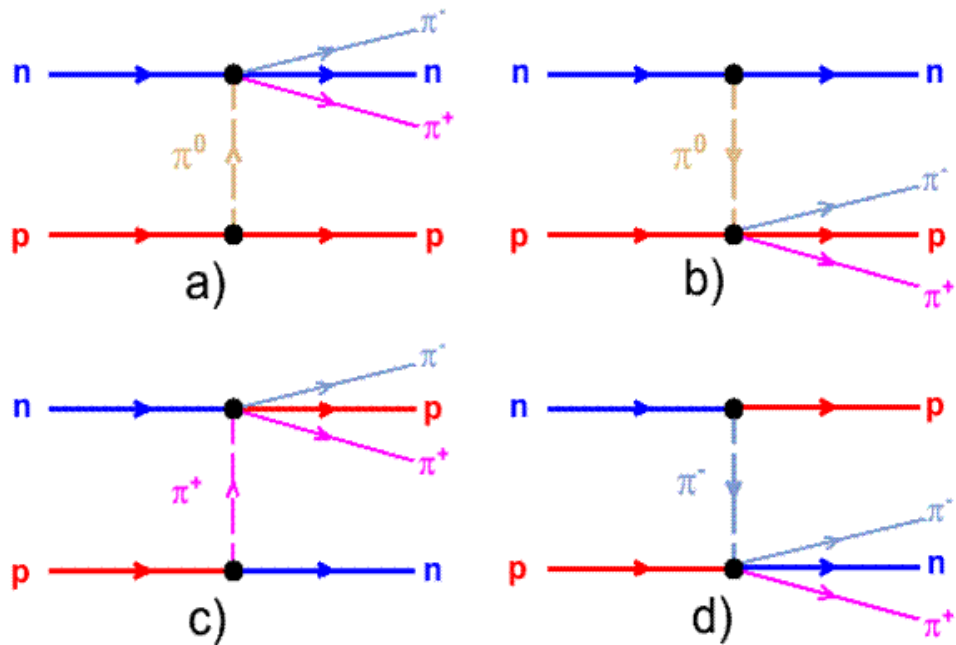
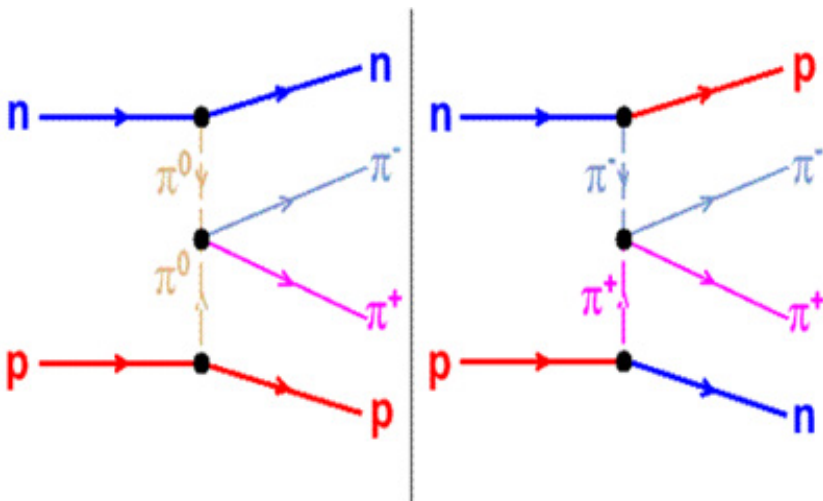
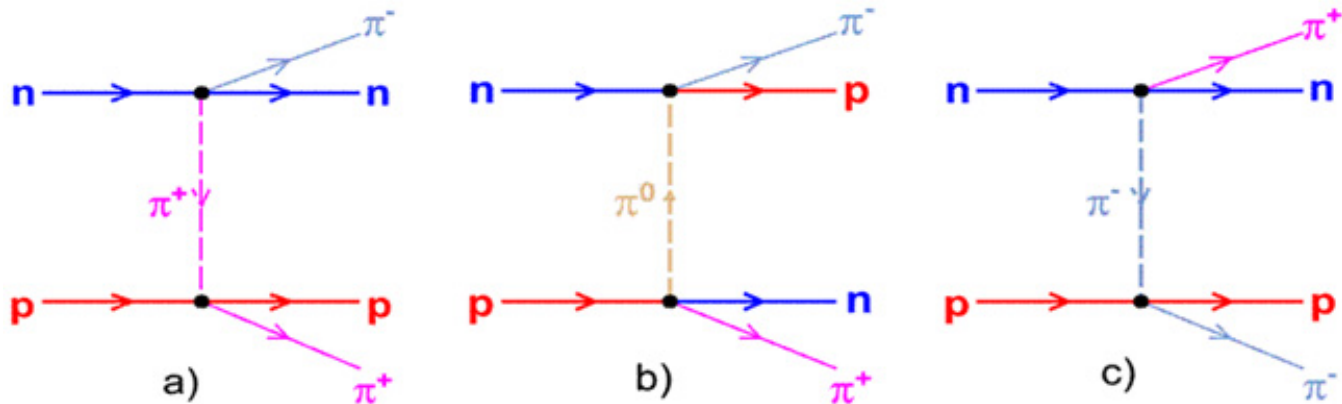
Angular distributions for $np \rightarrow pp\pi^-$ interaction



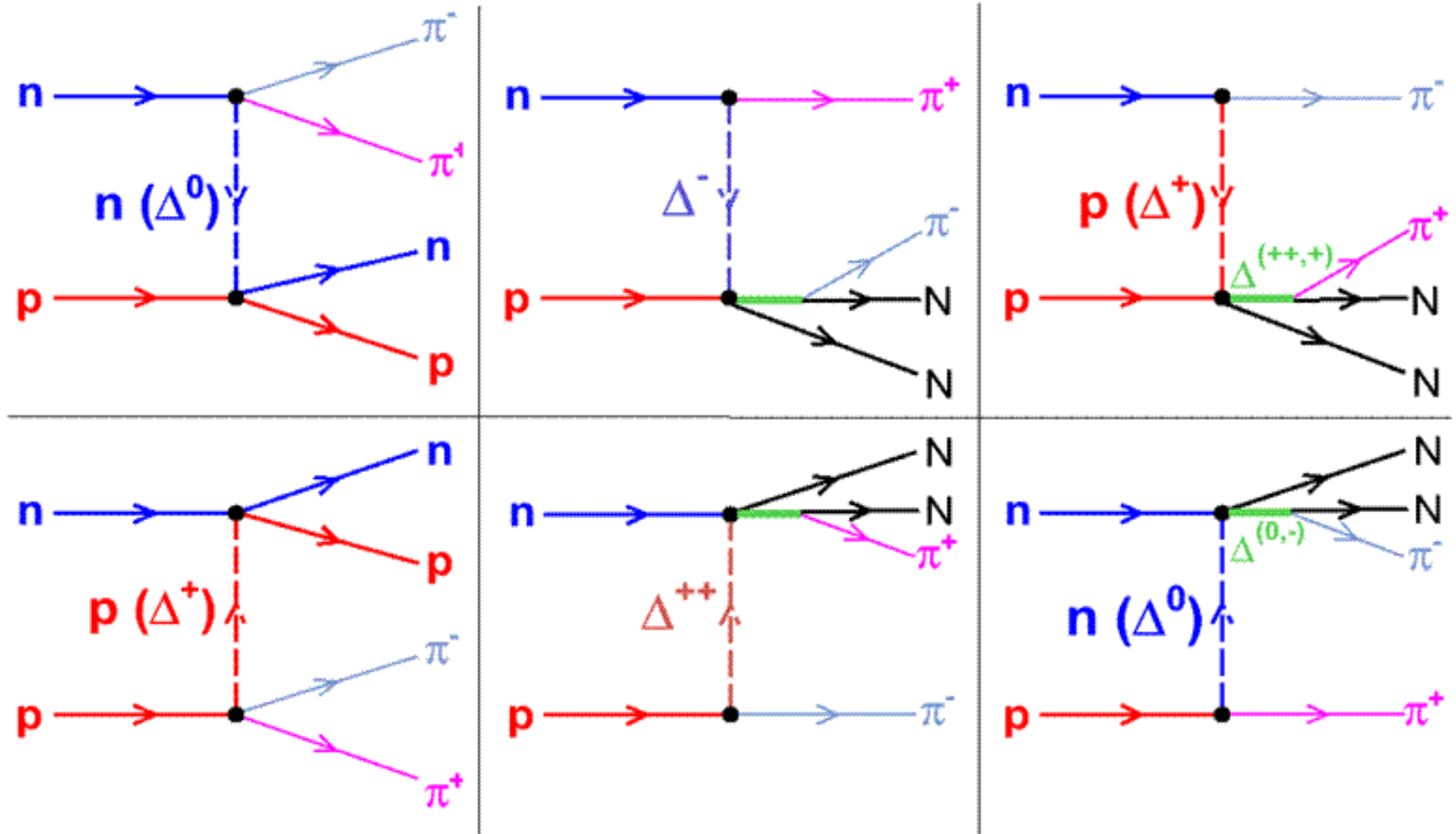
Angular distributions for $np \rightarrow np\pi^+\pi^-$ interaction



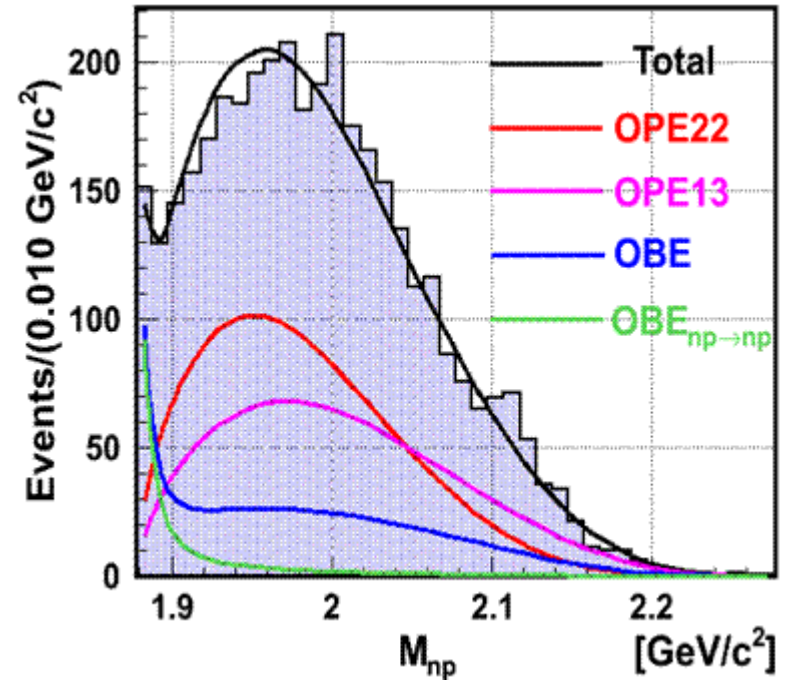
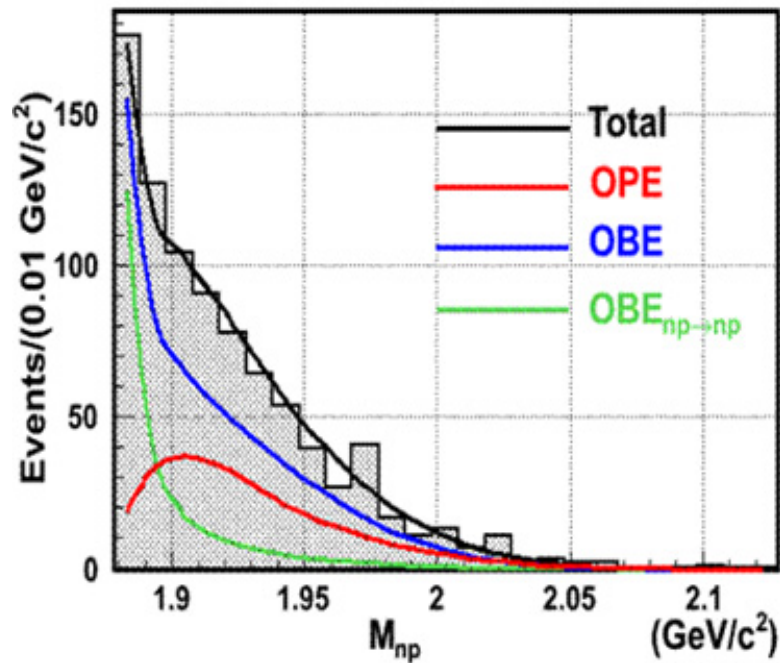
Model OPE + OBE : diagrams OPE



Model OPE + OBE : diagrams OBE



Experimental data for $np \rightarrow np\pi^+\pi^-$ at p 1.73 and 2.23 GeV/c



Experimental distributions for $np \rightarrow np\pi^+\pi^-$ at p 1.73 GeV/c

